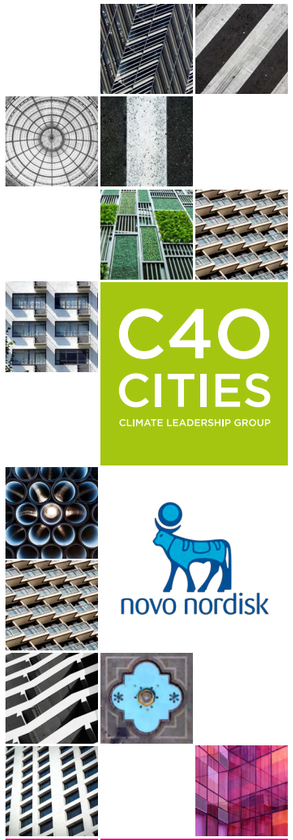
C40 CITIES
CLIMATE LEADERSHIP GROUP

BENEFITS OF CLIMATE ACTION

Piloting A Global Approach To Measurement

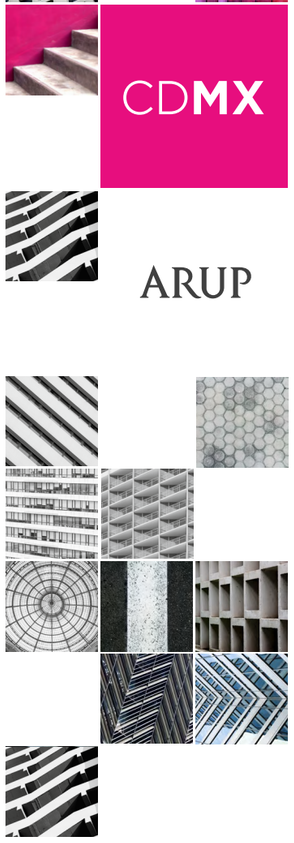


Partners and collaborators

The C40 Cities Climate Leadership Group (C40), now in its 11th year, connects more than 85 of the world's greatest cities, representing over 650 million people and one quarter of the global economy. Created and led by cities, C40 is focused on tackling climate change and driving urban action that reduces greenhouse gas emissions and climate risks, while increasing the health, wellbeing and economic opportunities of urban citizens.

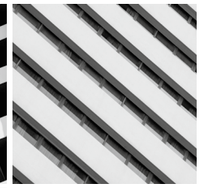
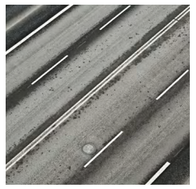
Novo Nordisk is a global healthcare company with more than 90 years of innovation and leadership in diabetes care. Novo Nordisk initiated the Cities Changing Diabetes partnership programme in response to the urgent challenge caused by the dramatic rise of diabetes in cities.

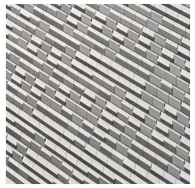
In late 2015, Novo Nordisk and C40 formed a research-based partnership aimed at ensuring that urban climate action is beneficial to both the environment and the health of urban citizens. This collaboration aims to generate new insights into a range of benefits of climate action – in particular the health of city populations. At the heart of the partnership lies the pivotal role of cities in the fight against climate change and poor health.



Mexico City is the pilot city for the measurement of the benefits from bikeability and walkability profiled in this report. This research would not have been possible without their participation, which has been fundamental to taking forward the complex but critical research on benefits; their leadership on this will benefit the whole C40 network.

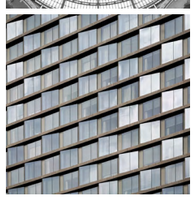
C40 commissioned Arup to support this research. Arup is the creative force at the heart of many of the world's most prominent projects in the built environment and across industry. They offer a broad range of professional services that combine to make a real difference to their clients and the communities in which they work.



C O N T E N T S

1	Foreword	3
2	The Benefits of Urban Climate Action	4
3	Enabling Action Through Research	6
4	Initial Findings: Demonstrating the Benefits of Bikeability and Walkability	10
5	Initial Findings: Understanding How Cities Can Measure Benefits	20
6	Making the Case for Liveable, Low Carbon Cities	24



1 Foreword

The Paris Agreement has set a clear target – limit global temperature rise to 1.5 degrees Celsius in order to prevent catastrophic climate change.

Now we need to deliver.

This research on measuring the benefits of climate action is critical to enabling the much needed step change in the speed and scale of climate action taken by cities in order to deliver the Paris Agreement.

We know that truly transformational and urgent action is needed on climate change – our research shows that C40 cities must take approximately 14,000 new climate actions by 2020. That means doing things faster and more efficiently, thankfully C40 is perfectly placed to support this.

We also know that making the case for climate action is one of the biggest barriers preventing city leaders from taking action. That is why I welcome this new report and the work that will flow from it.

This benefits research aims to equip C40 mayors with the evidence and tools to make the case for faster, broader climate action. By demonstrating the full range of benefits of climate action, C40 can help cities unlock action and avoid false trade-offs.

The pilot work highlighted in this report shows that climate action has a wide range of economic, social and environmental benefits. We provide evidence which demonstrates that climate action can not only reduce the impacts of climate change but also provide employment and support economic growth, as well as improving the health and well-being of citizens. Initial findings from our pilot work with Mexico City show that climate action to improve bikeability and walkability has created over 350 local jobs and saved the city $65 million US dollars. The increase in active lifestyles from biking and walking has had a huge range of benefits for the health and wellbeing of citizens, including dramatically reducing the risk of obesity and associated Non-Communicable Diseases, such as cardiovascular disease and type 2 diabetes.

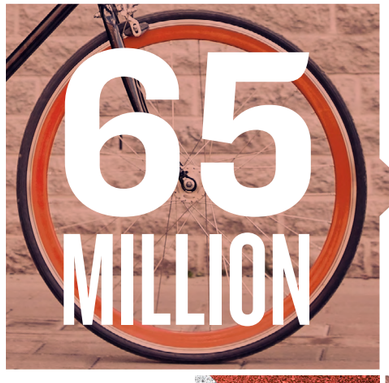
This pilot is the critical first step to measuring benefits - enabling C40 cities to make a stronger case for climate action and supporting the development of the healthy, liveable, low carbon cities of the future.

Mark Watts
Executive Director
C40

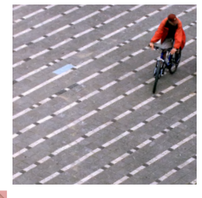
THE PEDESTRIANISATION OF MADERO STREET IS USED FOR AROUND 117 MILLION 1-KILOMETRE WALKING TRIPS A YEAR

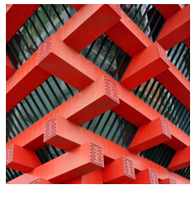
82% OF ECOBICI USERS NOTICED POSITIVE QUALITY OF LIFE IMPROVEMENTS SINCE THEY STARTED USING THE BIKE SHARE PROGRAMME

AN AVERAGE ECOBICI USER SPENDS 47–82 MINUTES PER WEEK DOING PHYSICAL ACTIVITY



THE POTENTIAL NET PRESENT BENEFITS OF MEXICO CITY'S BIKE LANES TOTALS MORE THAN US $65 MILLION, ALMOST 6 TIMES MORE THAN THE COSTS





CYCLING PREVENTS AN ESTIMATED 10 DEATHS IN MEXICO CITY PER YEAR DUE TO THE PROTECTIVE BENEFITS OF INCREASED PHYSICAL ACTIVITY

2 The Benefits of Urban Climate Action

This pilot research aims to enable cities to measure the wider benefits of climate action, empowering them to make a much stronger case for a much greater scale of action. The purpose of the research is to evidence the benefits of climate action, but more than this to understand *how* cities can evidence these benefits as efficiently, effectively and expeditiously as possible.

This report shares initial findings on measuring the wider benefits of climate action focusing on bikeability and walkability in Mexico City; specifically the introduction of bike lanes, a bike share scheme (EcoBici) and the pedestrianisation of a major avenue (Madero Street).

Climate action has a range of wider benefits for the health and prosperity of cities and their citizens.

The benefits of urban climate action – from green jobs and growth, to active, happier lives and cleaner air and water – have an immediate, tangible impact on people's lives.

Making the case for climate action is one of the leading challenges cities face to undertaking ambitious urban climate action.

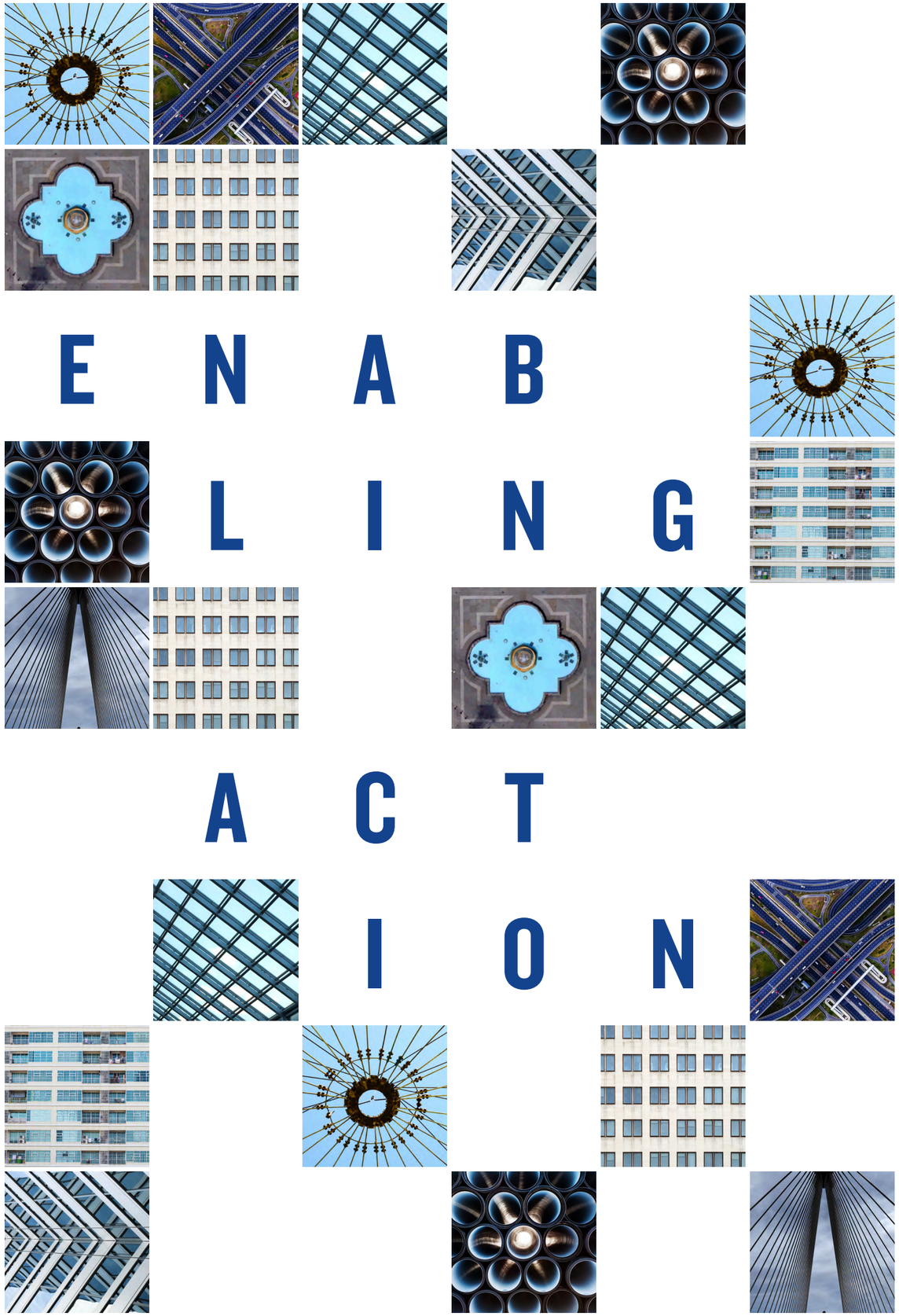
The ability to demonstrate these benefits is a critical first step to unlocking climate action. Cities need the evidence and tools to make a stronger case, enabling the staggering increase in the scale and pace of action required.

Inclusive climate actions present opportunities to forge a more equal, happy and prosperous society as well as a climate positive one.

Inclusive climate actions tackle multiple mayoral priorities simultaneously, deliver multiple benefits to all segments of the population, and ultimately result in more transformational climate solutions.

"SHOWING THE BENEFIT OF CLIMATE ACTION, HOW IT IMPACTS THE LIVES OF OUR CITIZENS AND SUPPORTS THE LOCAL, IMMEDIATE PRIORITIES FOR MEXICO CITY IS CRITICAL. THIS RESEARCH DEMONSTRATES THIS, SHOWING A WIDE RANGE OF BENEFITS FROM BIKEABILITY AND WALKABILITY ACTIONS, AND HOW THEY IMPROVE THE HEALTH, WEALTH AND LOCAL ENVIRONMENT FOR US."

Mayor Mancera, Mexico City



3 Enabling Action Through Research

3.1 The time for urgent climate action is now

The Paris Agreement represents a historic step in tackling climate change. It recognises that transformational and urgent action is needed and creates an unprecedented mandate and momentum for this. The global task now is to identify and deliver action at the tremendous pace and scale needed to achieve it.

Cities are central to achieving this ambition. They are responsible for 70% of global greenhouse gas emissions and home to more than 50% of the world's population. C40 and Arup's research on delivering the Paris Agreement indicates that C40 cities must reach zero net emissions by 2050 if they are to achieve the aspiration to keep the world below 1.5 degrees Celsius of global warming. Achieving this target requires an explosion in action; cities need to take approximately 14,000 new climate actions by 2020 (around 170 actions per city).[1] Each one of these actions will need political and financial support.

Yet one of the main barriers hindering cities from delivering climate action is effectively making the case for it.[2] Climate change is often seen as competing with a range of more immediate and tangible issues, such as lack of affordable housing, poverty, unemployment, and poor health. Without a holistic and persuasive case that articulates how climate action contributes to these priorities, it is challenging to attract the support required.

> **" WE KNOW CLIMATE ACTIONS HAVE WIDER BENEFITS FOR OUR CITIZENS, BEING ABLE TO EVALUATE THEM IS VITAL FOR US. BY UNDERSTANDING THE FULL BENEFITS OF POLICY AND PROJECTS WE CAN MAKE MORE INFORMED CHOICES AND TAKE ACTION THAT CREATES NOT ONLY CLIMATE POSITIVE CITIES BUT A BETTER QUALITY OF LIFE FOR OUR CITIZENS."**
>
> **Tanya Müller García**, Secretary for the Environment, Mexico City

1 *Deadline 2020*, C40-Arup Partnership, 2016.
2 *Potential for Climate Action* and *Unlocking Climate Action in Megacities*, C40-Arup Partnership, 2015.

3.2 Accelerating impact: Benefits research to unlock inclusive action

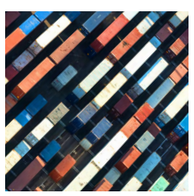
In response to this critical barrier, C40 has launched an enabling research programme on the benefits of inclusive climate action. This programme recognises the enormity of the challenge but also the scale of the opportunity; climate action has a wide range of benefits for health and prosperity and offers the potential to create not only low-carbon cities but more liveable cities where everybody has an opportunity for a better quality of life.

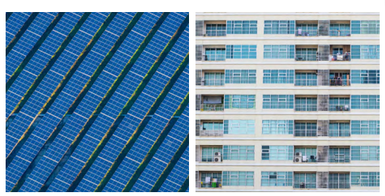
The focus on inclusive action recognises that cities face a range of competing priorities, and that in order to enable climate action cities need to address these short-term and local priorities as well. Similarly, the use of the term 'benefits' instead of co-benefits reflects the fact that climate change is often seen as competing with a range of more immediate and tangible issues. This focus on inclusive action and overall benefits not only better reflects the reality of cities but furthermore encourages integrated decisionmaking and encompasses all citizens – vital to enabling the scale and scope of action.

The research programme will focus on enabling the priority, high impact actions. By providing evidence of the full range of benefits from climate action, cities can avoid making false trade-offs and can drive urban development that reduces greenhouse gas emissions and climate risks, while increasing the health, wellbeing and economic opportunities of urban citizens.

"THIS FOCUS REFLECTS THE REALITY OF CITIES BUT FURTHERMORE ENCOURAGES INTEGRATED DECISION MAKING AND ENCOMPASSES ALL CITIZENS – VITAL TO ENABLING THE SCALE AND SCOPE OF ACTION."

Active commuting is associated with an 11% reduction in cardiovascular risk[4]





REDUCED CARDIOVASCLUAR RISK

3.3 Proof of concept: Piloting a practical approach to benefits measurement

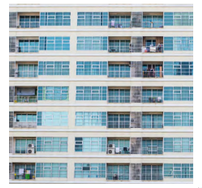
As part of the wider research programme, C40, in partnership with Novo Nordisk, launched this pilot project. This work sets out to break new ground on benefits measurement, paving the way for an ongoing global effort.

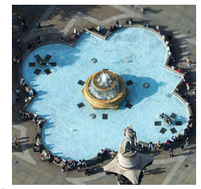
The aim is not only to add to the growing body of evidence confirming (at a city and project level) that climate action has wider benefits, but also to understand the art of the possible in measuring the benefits of urban climate action. How can cities evidence the benefits of climate action as efficiently, effectively and expeditiously as possible? And how can C40 and the wider research community best support this effort?

Given the urgency, it is vital to make the case for action now using the best available existing data. In parallel C40 will also work to improve the data cities have and strengthen the case in the future. And throughout it all it is important to develop a process that cities can practically and readily deploy.

Through this pilot C40 are developing and testing a standard and practical approach to measuring the benefits of five climate actions in four cities: bikeability and walkability in Mexico City; urban forestry in Melbourne; energy efficiency retrofits in New York City; and Bus Rapid Transit in Santiago.[3] This on the ground research provides valuable insights into how best to evidence the case for climate action.

Individuals in less walkable areas were up to 1/3 more likely to be obese or have diabetes[6]

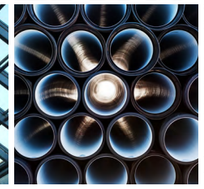


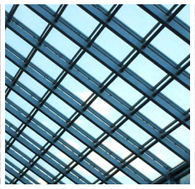


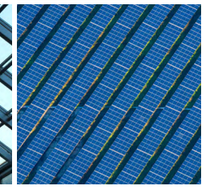
Individuals living in more walkable areas are more than twice as likely to walk, bicycle or use public transport[5]

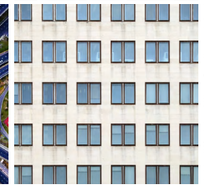
LESS PRONE TO DIABETES

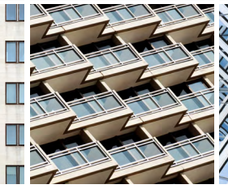
TWICE AS LIKELY TO WALK

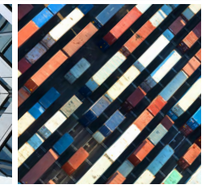




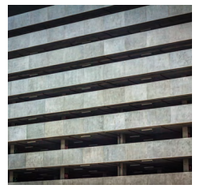




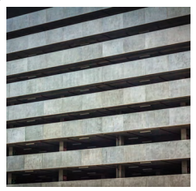




3 Note in Santiago this pilot compliments existing research the city is already undertaking. 4-6 See appendix for references



DEMONSTRATING BENEFITS



4 Initial Findings: Demonstrating the Benefits of Bikeability and Walkability

This report profiles initial findings from the pilot, focusing on the research and analysis undertaken with Mexico City. Social, environmental and economic benefits from the following climate actions are presented: the introduction of bike lanes; the introduction of EcoBici, a bike share scheme; and the pedestrianisation of Madero Street, a major avenue in Mexico City. Some wider findings from the pilot and global research on bikeability and walkability are also included.

The section starts by firstly outlining the actions in more detail and situating them within the wider Mexico City context. Then the results are presented as three infographics summarising the social, environmental and economic benefits. Finally, initial observations are given about how cities can measure benefits and the support they might need to do so.

This report presents a summary of the findings, a detailed description of the research approach and results is available in the online appendix;

www.c40.org/researches/measuring-benefits-appendix

A full report documenting the final findings from the research in all four cities will be available in early 2017.

> **“ IN MEXICO CITY, AND GLOBALLY, WE ARE FACING FUNDAMENTAL HEALTH AND CLIMATE CHALLENGES. THESE ARE INTERLINKED; THEY CAN EXACERBATE EACH OTHER OR THEY HAVE THE POTENTIAL TO PROVIDE A DUAL SOLUTION FOR THE HEALTH OF PEOPLE AND PLANET.”**
>
> **Dr. Armando Ahued**, Secretary of Health, Mexico City

4.1 Defining climate actions within the wider city and policy context

This section details the bikeability and walkabilty actions that were evaluated and the wider city and policy context in which they occur. This is critical because climate actions are not taken in isolation. Although benefits are measured in relation to a defined action for practical reasons, they are a product of the wider policy context. Benefits need to be considered in relation to this wider context, especially when drawing on findings from other cities.

City context

With over 21 million citizens Mexico City is the 4th largest city in the world, and the population continues to grow at 0.8% annually[7]

Mexico City

FOURTH LARGEST CITY

TWENTY ONE MILLION

0.8% GROWTH

Premature deaths in Mexico City linked to air pollution increased from 17,000 to 21,000 from 2005 to 2010[8]

It is estimated that 40B pesos ($2.2B) would be required annually to manage the city's air pollution challenges[9]

There are around 4 million vehicles in Mexico City[10] and this number grows by 4.2% annually[11]

Approximately 1,100 people die in Mexico City each year from road traffic accidents[12]

The reported prevalence of Type 2 diabetes is 13.9% for adults, and 74% are overweight or obese[13]

Drivers for action

21,000 PREMATURE DEATHS

40 BILLION PESOS REQUIRED

FOUR MILLION VEHICLES

1,100 ROAD TRAFFIC DEATHS

13.9% TYPE TWO DIABETES

74% OVERWEIGHT

The Mexico City Air Quality Program involves over 100 actions

Mexico City is part of the 100 Resilient Cities programme

The city's resilience strategy seeks to "improve mobility through an integrated, safe, and sustainable system"

Mexico City has funded biking and walking initiatives; the total amount spent exceeds $10,000,000[14]

Mexico City have power over cycling and walking assets and decision making, enabling the city to deliver bikeability and walkability action directly[15]

Enablers for action

OVER 100 ACTIONS

MORE THAN $10M FUNDING

CITY POWER

Policy context

Sustainable City Plan

Plan Verde

- **Published in 2007 Plan Verde (Green Plan) sets out a 15 year sustainable pathway for Mexico City including: $1Bn per year to develop transport, water, waste, land conservation and energy**
- **The cumulative emissions reduction over the lifetime of all of Mexico City's intermodal mobility actions is estimated to be 258,075 metric tonnes CO^2e [16]**

Cycling and walking strategies

Bicycle mobility strategy

- **Published in 2009 the bicycle mobility strategy sets out a coherent plan to roll out cycling infrastructure**
- **The strategy is underpinned by policies to create conditions to allow cycling to become a viable, safe, popular alternative**

Mexico City's walking strategy

- **Mexico City's walking strategy sets out a plan to improve pedestrian experience and reduce traffic congestion**
- **The strategy prioritizes pedestrians over cars; pedestrianising certain areas and making streets more walking friendly**

Climate actions evaluated as part of the pilot research

The introduction of bike lanes

- **The first recreational cycle route was launched in 2007, providing 10km of cycle way - this has grown to 40km today**
- **In 2010 6.4km of segregated road based lanes were added, this has increased to a current network of almost 60km**

The launch of the ecobici bike share scheme

- **EcoBici started with 1,200 bikes and 84 bike docks in 2010 and has grown to +6,000 bikes and 444 docks in 2015**
- **Currently over 100,000 users benefit from this service over a 35km^2 area**

Madero Street

- **Madero Street is a major avenue through Mexico City's historic center, in 2010 the street was pedestrianised**
- **Madero Street is over 11,000m^2 and almost 1km long**
- **On average 200,000 pedestrians use Madero Street each day**

7-16 See appendix for references

4.2 Social benefits of bikeability and walkability

ONE DEATH PER YEAR COULD BE PREVENTED FOR EVERY 61 PEOPLE WITH TYPE I OR TYPE 2 DIABETES WHO WALK AT LEAST 2 HOURS PER WEEK

REDUCED MORTALITY RISK

Copenhagen

A study in Copenhagen identified that cycling to work **reduces the risk of all-cause mortality by 28%**

REDUCED DIABETES RISK

It is estimated that there is a **10% increased risk of type 2 diabetes** per 10-mg/m3 fine particulate matter (PM2.5) exposure

A SAN FRANCISCO BAY AREA STUDY FOUND THAT INCREASING BIKING AND WALKING FROM 4 TO 24 MINUTES A DAY ON AVERAGE WOULD REDUCE CARDIOVASCULAR DISEASE AND DIABETES BY 14% AND DECREASE GHG EMISSIONS BY 14%

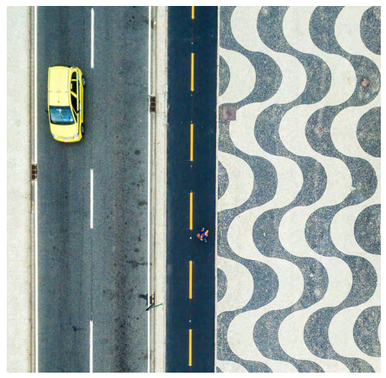
The benefits of increased physical activity from switching to cycling instead of driving show **a gain in life expectancy of 3-4 months**, outweighing the 0.8 to 40 life days lost through increased exposure to air pollution

3-4 LIFE MONTHS GAINED

Mexico City

Cycling prevents an estimated 10 deaths per year due to the protective benefits of increased physical activity

TEN DEATHS A YEAR PREVENTED



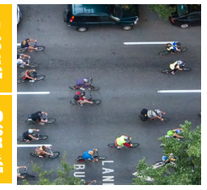
REDUCING DEMENTIA

Active lifestyles improve mental well-being – it is estimated that **physical inactivity accounts for approximately 3·8% of cases of dementia worldwide**

KEY: BIKEABILITY WALKABILITY

ECOBICI USERS

22%	MORE RELAXED	25%	BETTER HEALTH	65%	SPEND 41 HOURS PER YEAR CYCLING
82%	BETTER QUALITY OF LIFE	19%	MORE DISPOSABLE INCOME	35%	SPEND 71 HOURS PER YEAR CYCLING& WALKING



Mexico City

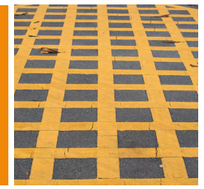
It is estimated that **26 hours of physical activity per user per year have been gained** due to use of EcoBici instead of less active modes of transport

26 HOURS

People who walk for more than 8.6 minutes per day are **33% more likely to report better mental health**

MENTAL WELL-BEING

DECREASED TYPE 2 DIABETES



Ontario

Walking regularly can consistently decrease the risk of type 2 diabetes, coronary heart disease, stroke and all-cause mortality

Higher neighbourhood walkability was associated with **decreased prevalence of overweight and obesity and decreased incidence of diabetes between 2001 and 2012**

Mexico City

Reported crimes along Madero Street have **decreased by around 96%**

INCREASED SAFETY

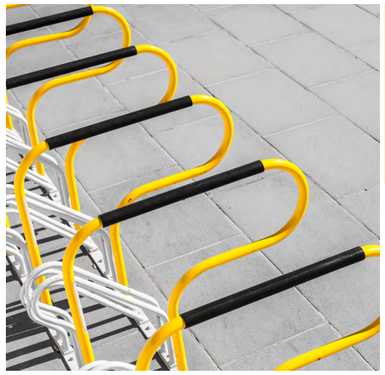
31-55% RECOMMENDED WEEKLY EXCERCISE

Mexico City

Time spent using EcoBici represents between 31-55% of the recommended weekly exercise

IN THE AVERAGE 7.5 MINUTES TAKEN TO WALK THE LENGTH OF MADERO STREET, A 60KG PERSON WOULD POTENTIALLY BURN 25 CALORIES EQUIVALENT TO 1/5TH OF A CAN OF SOFT DRINK

4.3 Environmental benefits of bikeability and walkability



GREENHOUSE GAS EMISSIONS SAVINGS

Mexico City

Total greenhouse gas emissions savings due to use of EcoBici instead of motorised modes are **nearly 1,190 tonnes per year**, equivalent to almost 2.6 million miles driven by an average passenger vehicle

REDUCTIONS IN AIR POLLUTANTS

Mexico City

Potential **reduction in air pollutants of 1.4 tonnes per year** due to mode shift from car to EcoBici

Mexico City

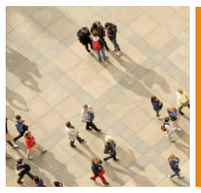
Replacing all city pavements with materials similar to white portland cement would **decrease the peak air summer temperature of cities by up to 0.5°c**

DECREASED SUMMER AIR TEMPERATURE

NOISE REDUCTION

Paris

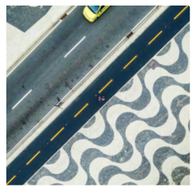
There was an **average noise reduction of 3 decibels on main roads** during the first car-free day in Paris



LOWERED AMBIENT TEMPERATURES

Seoul

The removal of a three-lane highway, restoration of the Cheonggyecheon River and construction of a pedestrian walkway in Seoul has **lowered ambient temperatures to 3°C below the city average**



United Kingdom

A study shows that noise exposure in the UK causes a loss of healthy life which is valued at €1.34 billion

It shows that **consistent day-time exposure over recommended noise levels has an impact on health**, including high blood pressure, stroke, dementia and heart disease

QUALITY OF LIFE

REDUCED URBAN HEAT ISLAND

By including green space and vegetation as part of bike lanes or pedestrian areas there is the **opportunity to reduce air temperature by 2-8°C**, a cooling effect that extends out into the surrounding area

AVOIDED CO2 EMISSIONS

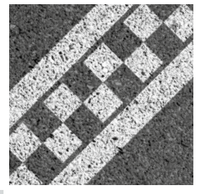
Barcelona

In Barcelona, the Bicing bike share scheme leads to an **estimated 9,062 tonnes of avoided carbon dioxide emissions** annually

Mexico City

Cooler streets - dark bitumen or asphalt road surfaces are typically highly absorbent of heat, abosrbing 95% of the sun's heat, whilst lighter surfaces for pedestrian areas, e.g. Portland cement, **absorb 82-85% of the sun's heat**

COOLER STREETS



KEY: BIKEABILITY WALKABILITY

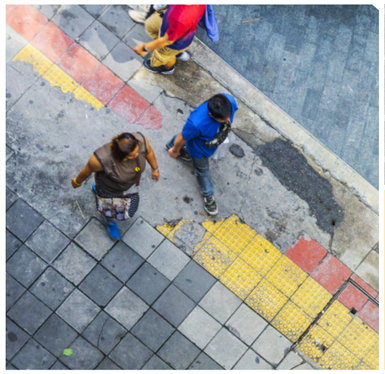
4.4 Economic benefits of bikeability and walkability

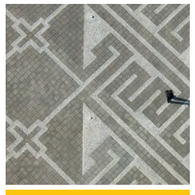
INCREASED SALES

New York

Establishing bike paths in Manhattan, New York, **increased local business retail sales by up to 49%**, compared with a 3% background increase in sales borough-wide

Developing bus and bike lanes in Manhattan, New York, helped to **reduce commercial vacancy rates by 47%**, compared with 2% borough-wide





REDUCED TRAFFIC

Mexico City

Reduction of traffic congestion and improvements in journey ambience are **estimated to yield $9 million of benefits**

ADDED VALUE

Washington, DC

In Washington, DC, after controlling for household income it was found that an **increase in walkability above a given threshold translates into an $8.88 value premium in office rents** and $81.54 per square foot premium in residential housing values

ACROSS A TOWN OF 150,000 PEOPLE, IF EVERYONE WALKED AN EXTRA 10 MINUTES A DAY, THE WHO HEAT MODEL ESTIMATES THAT 31 LIVES WOULD BE SAVED, WITH BENEFITS OF £30M PER YEAR

KEY: BIKEABILITY WALKABILITY

MEXICO CITY: THE ANNUAL VALUE OF SAVED LIVES DUE TO THE HEALTH BENEFITS OF INCREASED CYCLING AS A RESULT OF THE ECOBICI SCHEME IS ESTIMATED TO BE BETWEEN US $2,385,000 AND US $3,250,000 PER YEAR

Mexico City

The potential net present **benefits of Mexico City's bike lanes** totals more than US $65 million, almost six times more than the costs

$65 MILLION

REDUCED HEALTH COSTS

Mexico City

The major source of financial benefits from EcoBici accrues in relation to improved physical fitness, where the **value of benefits is estimated to exceed $44.6 million**

INCREASED COMMERCIAL ACTIVITY

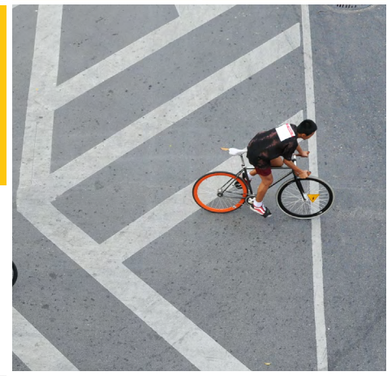
Mexico City

Commercial activity has increased by 30% since Madero Street was pedestrianised

MORE JOBS

Mexico City

The EcoBici bike share scheme **generated 366 jobs** between 2010 and 2015



THE MONETISED HEALTH BENEFITS DUE TO JOURNEYS IN MEXICO CITY TAKEN BY ECOBICI INSTEAD OF BY CAR OR TAXI ARE ESTIMATED AT $26 MILLION, BASED ON A TOTAL OF 23,954 CAR KILOMETRES REPLACED

AFFORDABLE TRANSPORT

Mexico City

The average car user in Mexico City's Sante Fe district spends over us $1,700 per year on gas and vehicle maintenance

By comparison, at **$20 per year EcoBici provides a far more affordable alternative** for local transportation

5 Initial Findings: Understanding How Cities Can Measure Benefits

As previously stated a key aim of this research is to understand the art of the possible in measuring the benefits of urban climate action. This section summarises the initial observations from the pilot about how cities can measure benefits and the support they might need to do so.

This research is framed around two key questions:

1 What benefits can be measured now, based on the data currently available in cities and feasible methods of analysis?

2 How can gaps in data and research be filled and what methods can be employed to improve the measurement of benefits in the future?

Based on these questions, the approach includes two principal components; data collection and data analysis. Raw data from each city is being collected and analysed, and combined with evidence from existing literature and tools to identify replicable methods for measuring benefits.

Data collection is based on a benefits framework setting out the ideal data required. Initial data is provided by the relevant city team and further data exploration is undertaken with a wider range of city departments and organisations.[17] In addition an extensive literature review is undertaken to identify data from similar research in other cities that could be used to fill gaps in 'raw' data from the pilot city.

The data analysis approach depends on the level of data available. Wherever the data is comprehensive enough analysis uses city data to directly demonstrate impact and benefit. In most cases insufficient data exists to do this so partial city data is combined with similar research in other cities. This research provides a multiplier that can be used to convert the patial data about the *action* taken into an estimate of the resulting *benefits*. Where existing tools have already been developed to help measure certain benefits these are also used in analysis.

Pilot testing of data collection and analysis approaches not only helps to understand how to use current data; it also highlights the opportunities for future work to expand the breadth and depth of benefits measurement methodologies. The initial findings on the main limitations and learnings are summarised below, full details are provided in the appendix available online at:

www.c40.org/researches/measuring-benefits-appendix

17 *Co-benefits of urban climate action: A framework for cities,* C40 and LSE Cities, 2016.

5.1 Limitations and learning for future research

Understanding critical data gaps

As well as identifying what data exists it is important to understand the data gaps. Key gaps identified in this pilot are the availability of pre- and post-action data; the availability of data at the granularity that corresponds to a climate action, i.e. is the area of data collection the same as the area of the climate action; a lack of context specific research from a similar city setting, especially for Low,and Middle Income Countries (LMIC); and insufficient data to enable a good understanding of how equitably the benefits are distributed. Furthermore, some data will have a much greater impact on results. Identifying the most critical data gaps and focusing data collection and research efforts on this will help cities and researchers make the most of the limited resources for monitoring and evaluation.

Integrating data sources to fill gaps

Analysis applied from city specific research to fill data gaps should ensure its contextual prevalence is considered prior. For example, if using data from other cities to estimate the increase in biking following the introduction of bike lanes, geographic factors such as distance and 'hilliness' and cultural factors such as base activity levels should be accounted and adjusted for. This has not been done within the scope of this pilot but is an important area for future research.

The importance of inclusive action

The lack of data, and therefore understanding, about the distribution of benefits is a particular issue. Understanding the equity of the distribution of benefits from climate action is of major importance given the striking inequities that exist in cities, and given the need for climate action to reach the whole population in order to achieve the scale and scope required. Further research to enable this is urgently required, as estimates can be strongly biased if these hidden patterns of inequality are ignored.

Assumptions and confidence

The findings in this report are based on a number of assumptions throughout the analyses to help arrive at feasible conclusions, and these are explained in the appendix. The findings are also based on a variable quantity and quality of data sources. It is important to present results with varying degrees of confidence according to the sources of data, strength of correlations and potential confounding factors. This pilot starts to build an evidence base of assumptions and data sources that can be built on to provide a consistent and robust approach to analysis.

Causation vs correlation

It is important to note that the findings presented here should be interpreted as potential correlations rather than clear causal relationships between actions and outcomes. Demonstrating causality is particularly challenging and resource intensive. Therefore it is especially important to focus and coordinate research efforts on causation on the most critical data gaps and across the key city contexts. Furthermore where this research does exist it should be made available to cities to use as widely as possible.

Benefits and net impact

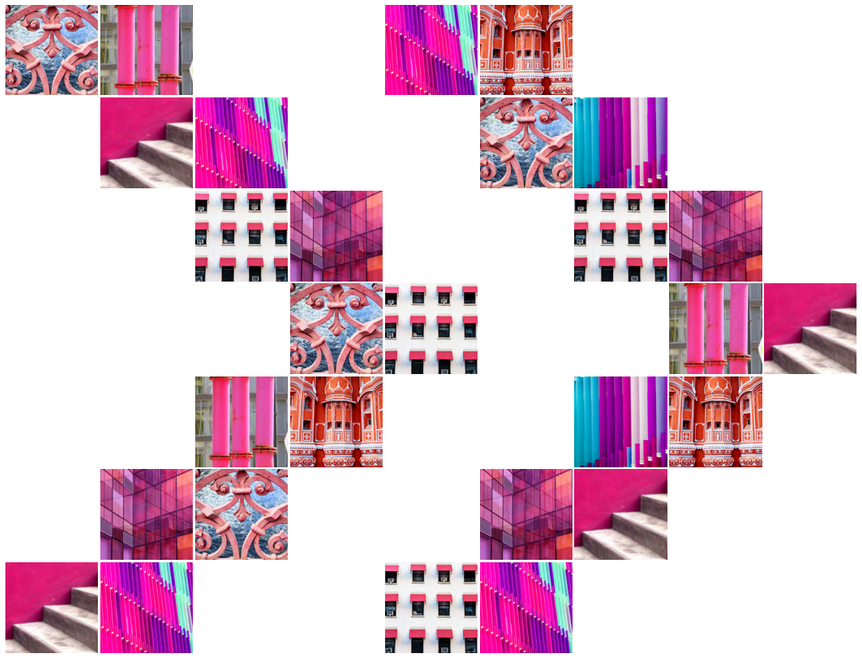
It should also be noted that this work has focused on measuring the benefits of climate actions. Only limited consideration of potential negative impacts ('disbenefits') has been undertaken. This is an important area for future work as it enables better evaluation of 'net' benefits and reduces the risk of potential negative side-effects of climate action.

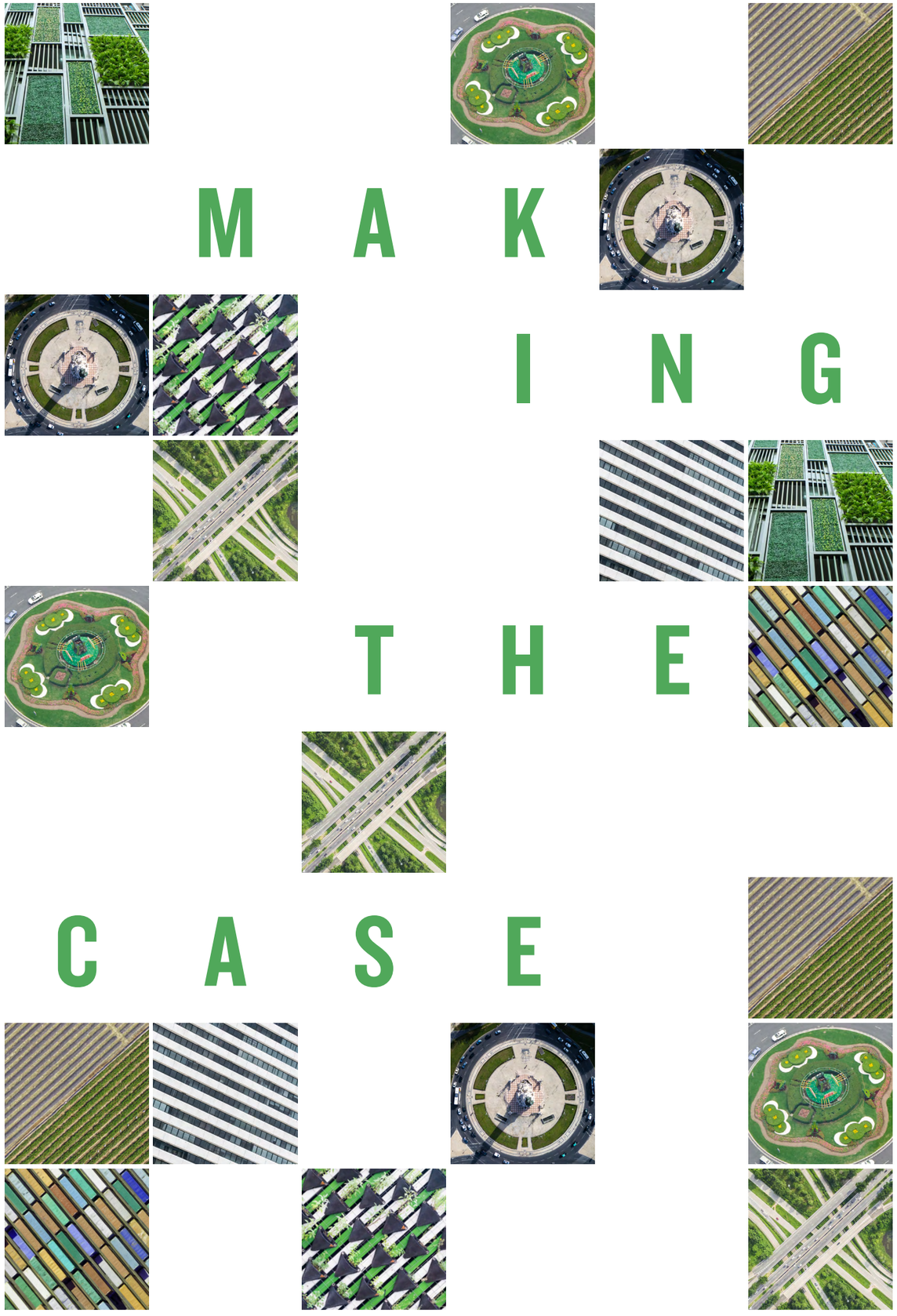
Measuring health benefits

Measuring health benefits is extremely complex. For example, in relation to bikeability and walkability most of the health benefits come from increased physical activity. The benefits from physical activity will depend on a number of factors, e.g. intensity, age and gender, and wider lifestyle and behaviours. This level of data is unlikely to be available and therefore limits measurement of health benefits. Future research should focus on building an evidence base across a range of city contexts that can then be drawn upon to enable better measurement of health benefits globally.

Distinguishing between individuals and the general population

It is important to distinguish between the benefits experienced by an individual affected by the action, compared with the benefits spread across the city population. This impacts decision making and facilitates communication for different audiences. For instance, per capita health gains for bike share users are expected to be much larger, and therefore much more convincing, than population per capita gains, particularly for interventions at smaller scale. At the same time, local stakeholders are more willing to engage with absolute population benefits, as this is more closely related to the planning and decision-making at the local level.





6 Making the Case for Liveable, Low Carbon Cities

This pilot research confirms the wealth of wider benefits resulting from climate action, and it helps demonstrate practical approaches for measuring these benefits. The initial findings point to a number of conclusions for the development of this research agenda, and for how best to support and empower mayors to make the case for liveable, low carbon cities.

Demonstrating the wider economic, social and environmental impacts makes a much stronger case for climate action.

This report shows the wider benefits of climate action and illustrates the positive impacts on the health and well-being of citizens, on the economic development of the city and demonstrates the cross-departmental benefits of investment in climate action.

By combining data sources, benefits can be estimated across economic, social and environmental indicators – from reduced crime rates along pedestrianised city streets, to jobs created by cycling infrastructure.

The findings demonstrate viable approaches to data collection and analysis for measuring the wide-ranging benefits of climate action based on data available today. This pilot study illustrates what is possible in terms of benefits measurement, using the data that cities typically have access to today, together with existing tools and the benchmarks available from wider research. This is a strong starting position for cities to begin quantifying benefits now, to make the case for urgent climate action.

There are numerous opportunities for further research that will help to improve the process of benefits data collection, analysis and interpretation, and the robustness of results.

These include: improving data availability targeting data that is most critical to benefits evaluation; expanding the range of context-specific benchmarks; and exploring new methods for combining and interpreting data.

Collaboration across city departments is important to understand how actions led by one department may yield benefits for another.

The study has helped to illustrate that the benefits of climate action are not limited to one sector or institution. By working together, city departments can make a more persuasive case for city-wide climate action, leveraging greater political and financial support while also improving the efficient use of departmental budgets.

By working together across the government, business and non-government sectors to develop the robustness of benefits measurement, we can accelerate climate action.

C40 is committed to building the evidence base on the benefits of climate action and enabling cities to improve their approach to measuring benefits. The best way to achieve this is for more partners to join in this effort. C40 calls upon the private sector, community groups, citizens and the research community to support this effort, and for cities to partner with us in developing and testing a globally relevant and replicable approach to benefits measurement.

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